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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No. PCT/DE02/04546

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step and commercial applicability; citations and explanations supporting such statement

1. STATEMENT

Novelty (N)	Yes:	Claims 1-30,32
	No:	Claims 31
Inventive Step (IS)	Yes:	Claims 1-30,32
	No:	Claims
Commercial Applicability (IA)	Yes:	Claims 1-32
	No:	Claims

2. CITATIONS AND EXPLANATIONS

see Addendum

EU 320194799 US

I. Basis of the Report

1. Regarding the **components** of the international Application (supplementary pages presented to the Examination Office in response to a request under Article 14, within the framework of this report are considered "as originally filed" and are not attached thereto since they do not contain any changes (Rules 70.16 and 70.17))

Specification, pages:

1-24 published version

Claims, No.:

1-32 received on 02/20/2004 by telefax

Drawings, pages:

1/6-6/6 published version

4. Due to the changes, the following documents are omitted:

Claims, no. 33-34

As to Point V

Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: DE 197 50,496 A (BOSCH GMBH ROBERT) May 20, 1999 (1999-05-20)

D2: DE 199 33 665 A (BOSCH GMBH ROBERT) January 18, 2001 (2001-01-18)

D3: US-A-5 241 857 (JUNGINGER ERICH ET AL) September 7, 1993 (1993-09-07)

Novelty and Inventive Step

1) Background of the Invention

Document D1 discloses a method and a device for determining the air mass aspirated by an internal combustion engine. To correct the measured air-mass signal, the atmospheric humidity of the aspirated air is recorded additionally and processed in the control unit. Recording the atmospheric humidity may in this case take place both outside of the intake manifold (for instance by means of an already present rain sensor), or inside the intake manifold (separate sensors or hybrid sensor). D1 discloses no further information as to how the air-mass signal and the atmospheric-humidity signal are linked or processed in the control unit.

Document D2 discloses an air-mass sensor having an evaluation circuit to compensate for measuring errors due to pulsating air masses in the intake manifold. In this method an additional auxiliary variable is derived from the air-mass signal and used to correct the air-mass signal.

Document D3, which is considered the most proximate related art for Claim 1 of the present invention, discloses a device for correcting measuring errors in an air-mass sensor. In parallel with the measuring of the air mass with the aid of an air-mass sensor (first method), the air mass is determined in this method on the basis of a second, independent method, for instance via the engine speed and the throttle-valve angle. The results of both measurements are processed in the control unit. Depending on the presence of a certain operating mode of the internal combustion engine, either the result of the first method or the second method is utilized.

2) Claim 1:

Claim 1 of the present application furthermore discloses a selection method/regulation method for determining a controlled variable or a valid air-mass sensor signal from two signals, which are ascertained independently of one another (air-mass sensor signal L_1 and auxiliary variable H_1). A selection criterion is derived from the signals L_1 and H_1 by difference formation, subsequent amount formation, filtering and comparison with a threshold value. On the basis of this selection criterion, either the air-mass sensor signal L_1 or the auxiliary variable H_1 will then be used as controlled variable or as valid air-mass sensor signal.

Such a method is neither known from the related art cited in the search report nor does it appear to be obvious from it.

Claim 1 of the present Application thus meets the requirements of Article 33(2) and (3) PCT.

3) Claim 31:

Claim 31 of the present application is not novel within the meaning of Article 33(2) PCT. Any computer program from the related art having a program code is suited to execute a method as recited in one of the Claims 1 through 30.

4) Claim 32:

Claim 32 of the present Application meets the requirements of Article 33(2) and (3) PCT. The arguments listed under Section 2) are applicable accordingly. Also compare section 5) in this context.

Clarity

5) As described below, some features in the device claim 32 refer to a method for using the device, and not to the definition of the device in the light of its technical features. Therefore, the intended restrictions cannot be clearly inferred from the claim, in contradiction to the requirements of Article 6 PCT:

Control device for an internal combustion engine … in which

- a positive differential signal is obtained from the differential signal by forming the amount;
- and a filtered differential signal is obtained by filtering the positive differential signal;
- the air-mass sensor signal is used as controlled variable when … falls below a predefinable threshold value;
- and the auxiliary signal is used as controlled variable when … exceeds a predefinable threshold value;

6) The present application does not conform to Article 6 PCT since the claims are not clear. Claims 11, 16-19 and 23-27 are in contradiction to Claim 1 or represent exemplary embodiments that are not able to be subordinated to Claim 1.

7) The present application does not conform to Article 6 PCT since the claims are not drafted concisely. Claims 5, 6 and 28 do not include any additional features compared to the claims to which they refer back.

8) Claim 27 is formulated as method claim but defines a device on the basis of a special sensor system. Claim 27 is thus not clear (Art. 6 PCT).

Additional Remarks

9) In contradiction to the requirements of Rule 5.1 a) ii) PCT, neither the relevant related art disclosed in the documents D1-D3, nor these documents, are mentioned in the specification.

10) The specification is not in accord with the claims, as stipulated by Rule 5.1 a) iii) PCT.

11) Commercial applicability of the method and device claimed in Claims 1 through 32 is obviously given.

10/500100
DT04 Rec'd PCT/PTO 26 JUN 2004
ART 34 AMDT

New Patent Claims

1. A method for operating an internal combustion engine (1), in particular of a motor vehicle, including a control unit (2) for controlling/regulating the internal combustion engine (1) as a function of an air-mass sensor signal (L_1), at least one first auxiliary signal (H_1) being used and the first auxiliary signal (H_1) or a signal derived therefrom being compared to the air-mass sensor signal (L_1) or a signal derived therefrom (220) so as to obtain a differential signal (D_1_1),
wherein
- a positive differential signal is obtained from the differential signal (D_1_1) by forming the amount (230);
- and a filtered differential signal (D_1_1*) is obtained by filtering the positive differential signal (D_1_1');
- the air-mass sensor signal (L_1) is used as controlled variable (R) if the positive differential signal (D_1_1') or the filtered differential signal (D_1_1*) falls below a predefinable threshold value S_1;
- and the auxiliary signal (H_1) is used as controlled variable (R)
- if the positive differential signal (D_1_1') or the filtered differential signal (D_1_1*) exceeds a predefinable threshold value S_1.

2. The method as recited in Claim 1, wherein the differential signal (D_1_1) is formed by the following steps:
- Differentiating the air-mass sensor signal (L_1) and the first auxiliary signal (H_1) (210, 211) to obtain a differentiated air-mass sensor signal (L_1_1) and a differentiated auxiliary signal (H_1_1);
- forming the difference (220) from these differentiated signals (L_1_1, H_1_1) to obtain a differential signal (D_1_1).

EU 320194799 US

3. The method as recited in Claim 2,
characterized by the following steps:
scaling (210a) of the differentiated air-mass sensor signal (L_1_1) to a time average (L_1_m) of the air-mass sensor signal (L_1), and scaling (211a) of the differentiated auxiliary signal (H_1_1) to a time average (H_1m) of the first auxiliary signal (H_1).

4. The method as recited in one of the preceding claims, wherein the first auxiliary signal is obtained from at least one of the following methods:

- state variables of the internal combustion engine;
- system model of an internal combustion engine;
- signal from an exhaust-gas probe;
- a second air-mass sensor (HFM_2);
- a rain sensor;
- an ultrasound sensor;
- a hot-wire air-mass sensor;
- a capacitive sensor;
- an ohmic sensor.

5. The method as recited in Claim 1,
wherein a comparison (200) of the first auxiliary signal (H_1) or a signal derived from the first auxiliary signal (H_1) with the air-mass sensor signal (L_1) or a signal derived from the air-mass sensor signal (L_1) is performed, a comparison result (VE) being obtained.

6. The method as recited in Claim 5,
wherein, as a function of the comparison result (VE), a controlled variable (R) is obtained for the control of the internal combustion engine (1).

7. The method as recited in Claim 4,
wherein the first auxiliary signal (H_1) is obtained from a signal of a capacitive sensor, the capacitive sensor being configured as integral component of the first air-mass sensor

(HFM_1).

8. The method as recited in Claim 4, wherein the capacitive sensor is configured as plate capacitor having a first and a second capacitor plate, the first capacitor plate being formed by a surface of the first air-mass sensor (HFM_1).

9. The method as recited in Claim 4, wherein the ohmic sensor includes at least two electrodes, preferably made of a corrosion-resistant material.

10. The method according to Claim 4 or 9, wherein the ohmic sensor is arranged on a surface of the first air-mass sensor (HFM_1).

11. The method as recited in Claim 1, wherein the comparison (200) includes the following steps: forming the difference (380) from the first auxiliary signal (H_1) and the air-mass sensor signal (L_1) to obtain the controlled variable (R).

12. The method as recited in Claim 11, characterized by the following step: filtering (340) of the air-mass sensor signal (L_1) prior to forming the difference (380) to obtain a filtered air-mass sensor signal (L_1*).

13. The method as recited in Claim 12, wherein a low pass filter (340a) is used for the filtering (340).

14. The method as recited in Claim 13, wherein the cut-off frequency of the low pass filter (340a) is selected dynamically and as a function of state variables of the internal combustion engine (1).

15. The method as recited in Claim 14,

wherein the cut-off frequency of the low pass filter (340a) is selected as a function of a model of the internal combustion engine.

16. The method as recited in Claim 1,
wherein the first auxiliary signal (H_1) is obtained by filtering (440) with a high pass filter (440a) from the air-mass sensor signal (L_1) and is used as a controlled variable (R) to control the internal combustion engine (1).

17. The method as recited in Claim 16,
wherein the cut-off frequency of the high-pass filter (440a) is selected dynamically.

18. The method as recited in Claim 17,
wherein the cut-off frequency of the high-pass filter (440a) is selected as a function of state variables of the internal combustion engine (1).

19. The method as recited in one of Claims 16 through 18,
wherein a second auxiliary signal (H_2) is obtained by filtering (442) with a low-pass filter (442a) from the air-mass sensor signal (L_1), and the controlled variable (R) is obtained from the first auxiliary signal (H_1), the second auxiliary signal (H_2) and state variables of the internal combustion engine (1).

20. The method as recited in Claim 19,
wherein the cut-off frequency of the low-pass filter (442a) is selected dynamically.

21. The method as recited in Claim 20,
wherein the cut-off frequency of the low-pass filter (442a) is selected as a function of state variables of the internal combustion engine (1).

22. The method as recited in Claim 18 or 21, wherein the cut-off frequency of the high-pass filter (440a) / low-pass filter (442a) is selected as a function of a model of the internal combustion engine (1).

23. The method as recited in Claim 4, wherein both air-mass sensors (HFM_1, HFM_2) are arranged in an intake manifold (4) of the internal combustion engine (1); air flowing into the intake manifold (4) first reaches the first air-mass sensor (HFM_1) and then reaches the second air-mass sensor (HFM_2), which is arranged with a clearance (D) in the flow direction of the aspirated air, and the comparison (200) includes the following steps: Delaying (510) of the air-mass sensor signal (L_1) by a delay time (delta_T) to obtain a delayed air-mass sensor signal (L_1_delta_T); subtracting (520) of the first auxiliary signal (H_1) from the delayed air-mass sensor signal (L_1_delta_T) to obtain a differential signal (D_L_H); integrating (530) the differential signal (D_L_H) to obtain an indicator signal (A_L_H); differentiating (540) the delayed air-mass sensor signal (L_1_delta_T) to obtain a differentiated air-mass sensor signal (L_1_delta_T_1); forming (541) the amount of the differentiated air-mass sensor signal (L_1_delta_T_1) to obtain a positive air-mass sensor signal (L_1_delta_T_1'); differentiating (542) the first auxiliary signal (H_1) to obtain a differentiated auxiliary signal (H1_1); forming (543) the amount of the differentiated auxiliary signal (H1_1) to obtain a positive auxiliary signal (H1_1'); subtracting (560) the positive auxiliary signal (H1_1') from the positive air-mass sensor signal (L_1_delta_T_1') to obtain a further differential signal (Z_Diff).

24. The method as recited in Claim 23, characterized by the following steps: Comparing (570) the indicator signal (A_L_H) with at least one threshold value if the indicator signal (A_L_H) exceeds a threshold value; obtaining (580) the controlled variable (R) from the first

auxiliary signal (H_1) and the indicator signal (A_L_H) if the differential signal (Z_Diff) is positive; obtaining (581) the controlled variable (R) from the air-mass sensor signal (L_1) and the indicator signal (A_L_H) if the differential signal (Z_Diff) is negative.

25. The method according to Claim 23 or 24, wherein both air-mass sensors (HFM_1, HFM_2) are arranged side-by-side, the delay step (510) is omitted, and the second air-mass sensor (HFM_2) is provided with a water-droplet separator.

26. The method as recited in Claim 25, wherein a model simulating the dynamic response of the water-droplet separator is taken into account in the processing of the air-mass sensor signal (L_1) and/or the first auxiliary signal (H_1).

27. The method as recited in one of Claims 23 through 26, wherein both air-mass sensors (HFM_1, HFM_2) are integrated in a shared sensor system, preferably in a shared housing.

28. The method as recited in one of the preceding claims, wherein, for the control/regulation of the internal combustion engine (1) as a function of an air-mass sensor signal (L_1) from a first air-mass sensor (HFM_1), at least one first auxiliary signal (H_1) is utilized, and, as a function of the first auxiliary signal, the influence of an interference variable (S_X), which affects the air-mass sensor signal (L_1), on the regulation of the internal combustion engine (1) is reduced.

29. The method as recited in one of Claims 4 or 28, characterized by the following steps: Deriving the interference variable (S_X) from the first auxiliary signal (H_1); obtaining the controlled variable (R) as a function of the interference variable (S_X).

30. The method as recited in one of the preceding claims, wherein the first air-mass sensor (HFM_1) is configured as hot-film air-mass sensor.

31. A computer program for a control unit of an internal combustion engine, particularly of a motor vehicle, having a program code for executing the method as recited in one of Claims 1 through 30 when it is executed on a computer or control unit.

32. A control unit (2) for an internal combustion engine (1), in particular of a motor vehicle, for controlling/regulating the internal combustion engine (1) as a function of an air-mass sensor signal (L_1) of a first air-mass sensor (HFM_1), at least one first auxiliary signal (H_1) being used and the first auxiliary signal (H_1) or a signal derived therefrom is compared to the air-mass sensor signal (L_1) or a signal derived therefrom (220) to obtain a differential signal (D1_1),
wherein
- a positive differential signal is obtained from the differential signal (D_1_1) by forming the amount (230);
- and a filtered differential signal (D_1_1*) is obtained by filtering the positive differential signal (D_1_1');
- the air-mass sensor signal (L_1) is used as controlled variable (R)
  if the positive differential signal (D_1_1') or the filtered differential signal (D_1_1*) falls below a predefinable threshold value S_1;
- and the auxiliary signal (H_1) is used as controlled variable (R)
  if the positive differential signal (D_1_1') or the filtered differential signal (D_1_1*) exceeds a predefinable threshold value S_1.